ENGINEERING AND TECHNICAL SERVICES
FIELD VALIDATION TECHNIQUES
A TECHNICAL BRIEF FROM CONNECTED NATION

June 22, 2011

Introduction

Connected Nation, Inc. is a not-for-profit working across states and with the federal government to implement the State Broadband Data and Development (SBDD) program created by the Broadband Data Improvement Act of 2008 and funded by the American Recovery and Reinvestment Act of 2009, and is managed by the National Telecommunications and Information Administration (NTIA) within the Department of Commerce. One of the main components of the SBDD program is the creation of a detailed, nationwide map of broadband coverage in order to accurately pinpoint remaining gaps in broadband availability across the nation. Connected Nation is the largest mapping agent across the nation supporting the SBDD program, working in Alaska, Florida, Iowa, Kansas, Michigan, Minnesota, Nevada, Ohio, Puerto Rico, South Carolina, Tennessee, and Texas to collect, process, integrate, and validate provider data, and map the broadband inventory across these jurisdictions.

Connected Nation's methodology for fulfilling the charge of the SBDD program starts with first establishing a trustworthy relationship with the dozens and sometimes hundreds of providers in each jurisdiction. Our mapping and engineering experts work with the providers to understand what data they have or can develop in-house describing their service territory by speed tier. Connected Nation then processes these data through a validation process that helps ensure the accuracy of the mapping data. This validation process is informed with, among other methods, broadband inquiries provided by consumers and local stakeholders about the information depicted through Connected Nation's interactive broadband maps. This crowdsourcing approach is instrumental in helping guide our validation process. Where providers are unable or unwilling to participate in the program and share data about their service territory, Connected Nation implements an estimation of their service territory using various techniques.

This white paper provides an overview of Connected Nation's methodology for provider outreach and relationship management, consumer data collection, and analysis to leverage crowdsourcing data stemming from broadband inquiries, and field validation of data volunteered by thousands of participating broadband providers. The memorandum also describes Connected Nation's methodology for estimating the broadband coverage of providers who do not chose to participate in the SBDD program and volunteer estimates of their service territory.

Provider Relationship Management

Over the past two years, Connected Nation's Engineering & Technical Services ("ETS") team has created a strong rapport with broadband providers on a local and national level. The goal was to develop trustworthy relations with

thousands of providers across the jurisdictions where we are charged with completing a broadband inventory map: Alaska, Florida, Iowa, Kansas, Michigan, Minnesota, Nevada, Ohio, Puerto Rico, South Carolina, Tennessee, and Texas. Beginning with an initial database of several thousand potential providers two years ago, the ETS team has contacted every known provider of broadband services in 12 U.S. states and territories, spoken with provider executives and broadband technicians, identified that the companies were viable providers of backhaul and residential broadband services, and learned about each of the 1,400 viable broadband service businesses. The ETS team has worked with providers, large and small, to understand what data they had available or could develop within the allotted time; it has collected these data and in tandem with Connected Nation's mapping team of GIS technicians, validated, integrated and ultimately mapped the service territory of approximately 1,400 providers.

The NITA requires two annual updates to the SBDD mapping data, in the spring and fall. During these biannual mapping cycles, each provider is contacted at least three times by ETS team members by e-mail or telephone. Each year, providers rely on Connected Nation's ETS team members as well for information about mapping updates or federal programs. While in the field, ETS team members also meet and talk face-to-face with broadband business owners, ask questions, and learn a variety of useful information:

- What challenges do providers face in the current business environment?
- Which providers are growing and which are contracting?
- Which providers seek help and which have received assistance?
- Which providers are reluctant to participate in special programs?
- Which providers have compelling success stories that can be shared?
- Who is pushing the envelope to extend broadband services in new ways and to more remote locations?
- How is new broadband deployment financed in different regions and for different platforms?
- How have federal stimulus funding programs impacted the business?
- Do providers find the annual RUS funds accessible and practical to manage?

Members of the ETS team regularly attend provider conferences and trade shows to stay abreast of ever-changing regulatory and technical advances. On many occasions, the attending ETS team member is participating as one of the defining speakers to share knowledge on broadband mapping, digital literacy, broadband adoption and sustainability programs, and to report on real-time research analysis conducted by Connected Nation.

Consumer Data Collection and Analysis

Broadband inquiries ("BBI"s) are submitted frequently by consumers via Connected Nation's state-level websites. Inquirers often seek help to identify local broadband provider options, or to learn when a specific provider may be able to provide service at a particular location. Consumer comments also provide information which may help validate the underlying mapping data.

To date, Connected Nation has received more than 20,000 BBIs, representing a large crowdsourcing database of service information and consumer experiences. The primary objectives of Connected Nation regarding these inquiries are to 1) improve the accuracy of the state maps with submitted consumer information and follow-up field research, 2) provide broadband options to consumers through cooperation with mapped providers and by facilitating new broadband service options, and 3) map and analyze information from consumers about areas of unmet broadband demand and alternatives to currently mapped services.

The process for responding to a BBI is straightforward, while the tools used by the ETS team are varied. Tools include the state BroadbandStat maps, ArcGIS Explorer for reviewing (i) confidential provider inventory maps, (ii) geocoded BBIs; and (iii) geocoded tower location maps, provider data submission updates, provider websites, QuickBase, the Federal Communications Commission ("FCC") Spectrum Dashboard, FCC Universal Licensing System and Antenna Structure Registration databases, and a plethora of other useful resources.

Following completion of desktop research and a provider inventory for the BBI address, an ETS team member speaks directly to the BBI consumer to gather more specific information, with the objective of either: a) confirming or revising the BBI's provider inventory, or b) gathering information about possible broadband options near the BBI address.

While the mapping engine is designed to capture the **supply** of broadband services in any particular state, the BBI process has the ability to capture **demand** information, and measure that demand against the available supply. Examples of questions that may be answered by a completed BBI dataset:

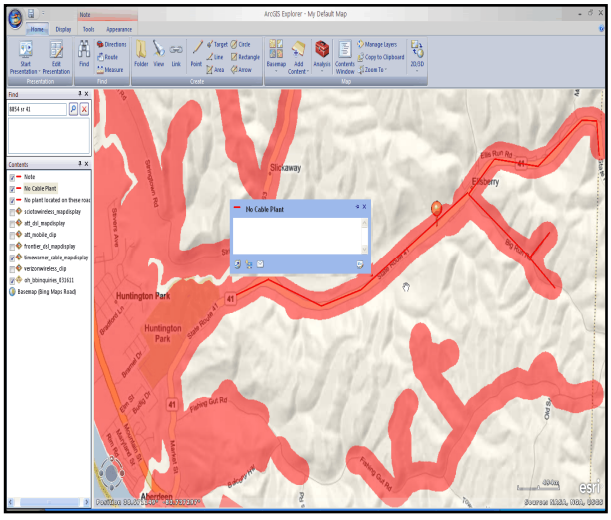
- Where are there concentrations of unmet demand (e.g., neighborhoods, lakeshores, school district boundaries)?
- Where are areas where consumers say price is a barrier for broadband adoption?
- Which providers are most often reported as mapped, but not providing service?
- How many unserved consumers are close to a wireless tower, and how many might be able to receive wireless broadband with installation of a signal repeater?

- What service platform is most requested by BBI consumers?
- What service providers are most often requested by BBI consumers?

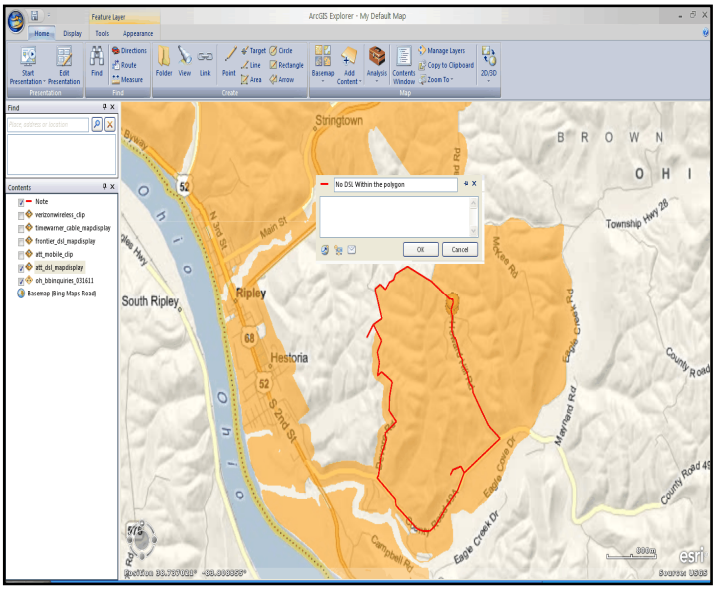
The answers to these and other questions present opportunities to Connected Nation for identifying and participating in broadband expansion opportunities and challenges.

Following the completion of the provider inventory with the consumer, the ETS team member can offer the consumer location-specific options for obtaining service, such as providing contact information for providers that the consumer was unaware were available, including satellite providers offering service and equipment assistance in certain situations. Potentially, the BBI process can capture information related to satellite referrals and other data points. Further, in instances where the provider inventory indicates a mapping discrepancy, the GIS department can potentially capture information related to census-block and road-segment reporting. Such information can yield other information, such as which platform is more likely to be overstated due to these issues, or what percentage of the mapped population is affected by use of these reporting blocks.

Field research for BBIs provides yet another important layer to the validation efforts which ultimately help to improve the broadband maps for each state. One specific BBI recently submitted by a consumer through a Connected Nation state website led to the validation example below. The BBI stated that the online broadband map indicated cable service availability where none actually existed. In this case, the consumer claimed to have contacted the broadband provider, and was unable to obtain service.



Although Connected Nation's GIS department could have simply created a "pin-point polygon" around the customer's home demonstrating no service on the Connected Nation online broadband mapping platform, follow-up calls to the consumer indicated a larger potential problem: the consumer commented on the mapped area stating that cable modem service is "generally unavailable for several miles on my road." The ETS team elected to conduct on-site research, and the results of the field validation effort produced a fairly noticeable mapping refinement (the pink shading at right represents the provider service area while the dark red line indicates where there is no cable plant).



Mapping discrepancies similar to the example above are certainly to be expected in areas where providers submit census-block data. At left, the red-line polygon indicates an unserved area within the orange-shaded service region. This discussion drives home the importance of BBI, crowdsourcing information and the field validation effort as a way of resolving broadband inquiries, improving the broadband maps, and responding more fully to clients, the general public demanding broadband, and other stakeholders.

Field Data Collection

Connected Nation's ETS team has driven nearly 100,000 miles and completed thousands of on-site validations of data submitted by the thousands of broadband providers included in Connected Nation broadband maps. Provider field validations are performed throughout the calendar year to meet NTIA requirements, as well as to test and confirm provider service boundaries, deployed assets, broadband speeds, and delivery platforms. ETS team members utilize a variety of resources for validation support, including provider coverage maps, FCC databases, and volunteered provider data submissions. Validation locations are selected based on a broad set of criteria, and include all platform types. A significant benefit to field work is that the ETS team gains a better understanding of the local broadband environment while on-site, and can identify previously unknown broadband providers – particularly, fixed wireless providers. Such first-hand knowledge can be an important asset in informing future programs.

Various tools, visual inspections, and tests provide the basis for a validation report. ETS engineers utilize spectrum analyzers and frequency-tuned antennas, GPS devices, cameras, and mapping programs to test, capture, and record validation information. All validation information can now be recorded directly into Connected Nation's QuickBase tool for geocoding, review, analysis, and reporting. Using common laptop computer software, ETS engineers can

access open broadband connections, determine the first-, middle-, and last-mile providers for an Internet connection, and complete speed tests through Connected Nation's online speed test tools or through other speed-test utilities.

Visual confirmation of a provider's presence in a community includes visiting provider offices and network operations centers, identifying and inspecting overhead (utility pole) and underground (pedestals and cabinets) gear labeled with provider names, seeking print-media listings and outdoor advertisements, researching federal licenses and local franchises, and testing wireless frequencies for transmissions and signal strengths. Validations may also include direct communication with broadband consumers in the provider's service area.

Data Validation of Participating Provider

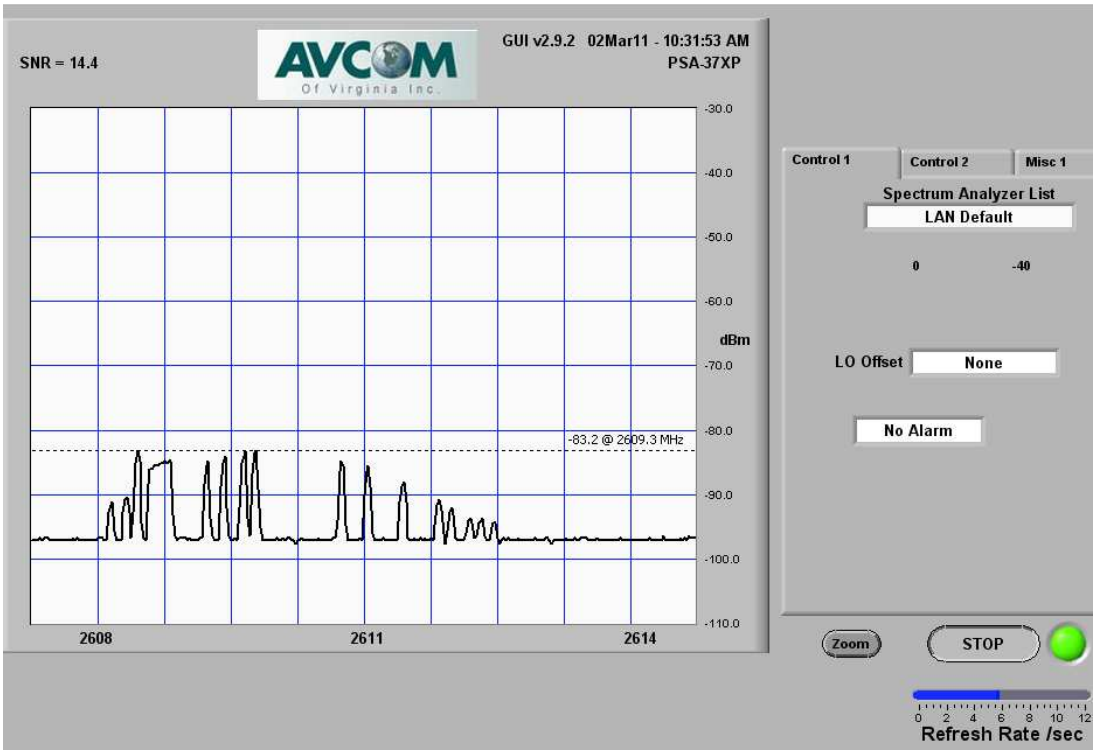
Field validations on data volunteered by broadband providers begin weeks in advance of the field trips as members of the ETS team work to prioritize an area of the state for field visitation. As described above, this process is also informed by crowdsourcing data collected through broadband inquiries from the general public. The next task involves identifying all viable providers in the defined area and determining their current level of participation in the broadband mapping program. Contact attempts are made to schedule on-site visits with providers to engage active participation in the validation process and to further the relationship. Lastly, ETS specialists will research the FCC Spectrum Dashboard to identify licensed mobile and fixed wireless spectrum users in the area. Armed with relevant data, provider appointments and an arsenal of test equipment (as shown below), the ETS team member sets out to determine how closely the actual broadband environment matches the graphic depiction displayed on the Connected Nation state-level interactive broadband map.

The video available at this link http://www.youtube.com/watch?v=tNMEQKHbDls provides an example of a typical Connected Nation field validation performed by ETS member Dwayne Goodman in Midlothian, a community south of Dallas, Texas.

Another typical field validation exercise was conducted on broadband data provided to Connected Nation by a fixed wireless provider in Michigan using licensed BRS spectrum to deliver broadband services across mostly rural areas in the upper portion of Michigan's lower peninsula.

The ETS member is armed with a propagation map such as the one depicted below displaying coverage in Alden, MI, which is 21.5 miles from the wireless provider's transmit site west of Traverse City, MI. Using the data submitted by the provider, the ETS team conducting this field validation calculated a receiver threshold at the test point of approximately -81dBm using a 9dBi gain receive antenna, and an actual field reading of -83.2dBm, as depicted in the chart below.


Torch
Lake
Elk Rapids
Alden
Rapid City
Acme
Barker Creek
Williamsburg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AVCOM
Of Virginia Inc.
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PSA-37XP
-30.0
-40.0
-50.0
-60.0
dBm
-70.0
-80.0
-83.2 @ 2609.3 MHz
-90.0
-100.0
-110.0
2608
2611
2614
Control 1
Control 2
Misc 1
Spectrum Analyzer List
LAN Default
0
-40
LO Offset
None
No Alarm
Zoom
STOP
0 2 4 6 8 10 12
Refresh Rate /sec

Occasionally, field validations uncover information that is contrary to data submitted by a provider. One such instance involved a Michigan Competitive Local Exchange Carrier (CLEC) that had provided coordinates for a remote terminal, a field enclosure that houses DSL distribution equipment (see picture below).

The CLEC affirmed they provided DSL services to the surrounding community over copper owned by the Incumbent Local Exchange Carrier (ILEC), but from equipment owned by the CLEC.

An ETS team member drove to the listed coordinates and located underground telephone pedestals belonging to the ILEC, but there was no remote terminal enclosure belonging to the CLEC. What was found at that location was a concrete pad with empty conduit. This suggests that someone prepared for an enclosure to be installed, but no equipment is in place and no wires have been installed. Such field validation is then used to make relevant corrections to that provider's estimated broadband service territory.

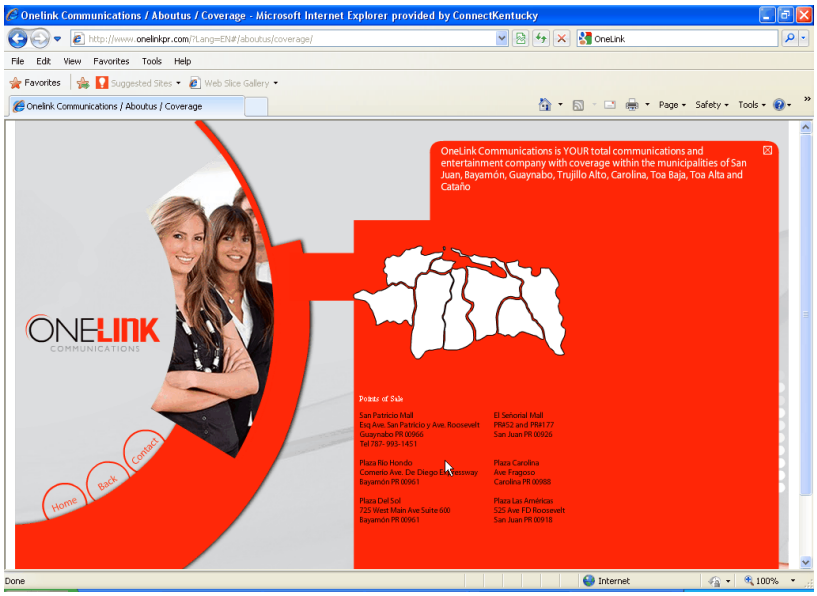
Data Submission of Non-Participating Provider

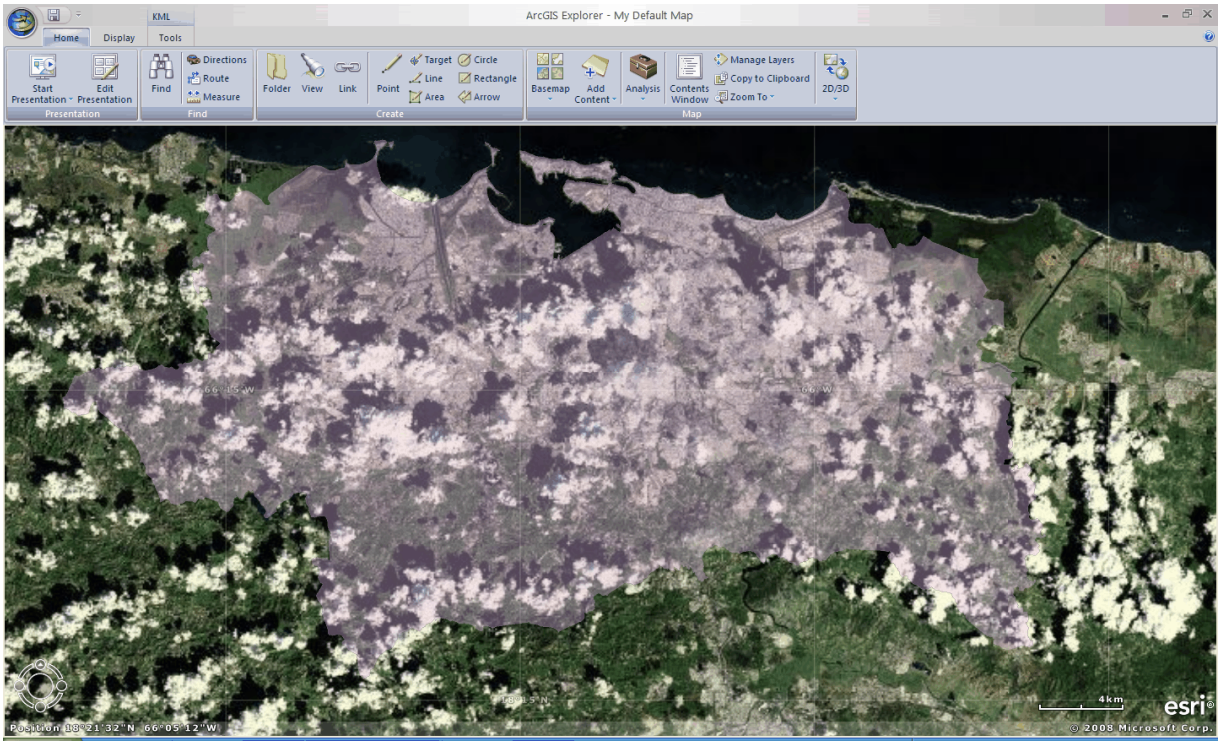
In instances where providers are unable or unwilling to participate in the data collection process, Connected Nation has developed an internal "play book" of best practices necessary for extraction of data from a combination of field validation techniques paired with publically available data. One such example includes Connected Nation's estimation of San Juan Cable, LLC's, or OneLink Communications', service territory for the cable broadband provider in the greater San Juan area in Puerto Rico. Connect Puerto Rico, a wholly owned subsidiary of Connected Nation, is working for the Office of the Chief Information Officer of Puerto Rico (OCIO) to implement the SBDD program across Puerto Rico.

Background: Following the protocols described in this memorandum, from September 2009 to the present, Connected Nation's staff, as well as staff from OCIO, have reached out to OneLink Communications on numerous occasions to inform them about the SBDD mapping program goals and processes and engage the company in a secure, trustworthy partnership to ensure accurate mapping of its broadband service territory. Despite Connected Nation's and OCIO's best efforts, to date we have been unable to engage OneLink Communications in meaningful discussions about its broadband service coverage.

Identification of Provider's Legal Name, d.b.a., and FRN: Connected Nation began building a file of OneLink's profile based on anecdotal information and, as time progressed, enriched the file with information obtained through the public domain. For example, Connected Nation received information from the Junta Reglamentadora de Telecomunicaciones de Puerto Rico ("JRT") indicating that territory once operated by Adelphia was the same territory now operated by OneLink. A search for a Federal Registration Number ("FRN") on the FCC **CO**mmission **RE**gistration **S**ystem ("CORES") system did not yield results. It was later discovered that the entity of record with the JRT was, in fact, San Juan Cable, LLC. A new search on the FCC CORES site yielded an FRN of 0013778857 and additional contact data.

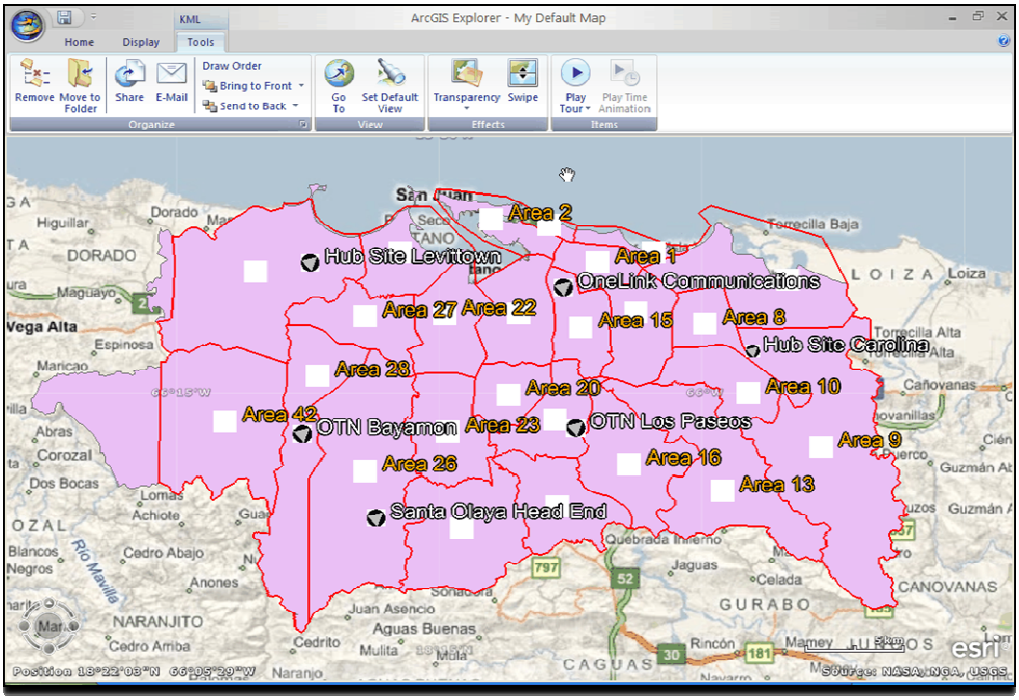
Identification of Provider's Coverage Area: Connected Nation extracted the municipality boundaries where the company operates from OneLink's publicly available website (see first illustration below) and used the company's published boundaries to create a GIS shapefile (see second illustration below) of the greatest advertised broadband package offered across OneLink's service area.





These polygons were then compared against generic data supplied by OneLink during the course of attempted communication (see comparative illustration below). The purple shaded area is Connected Nation's coverage

polygon extracted from OneLink's website and the red outlines illustrate the franchisee boundaries submitted by OneLink.

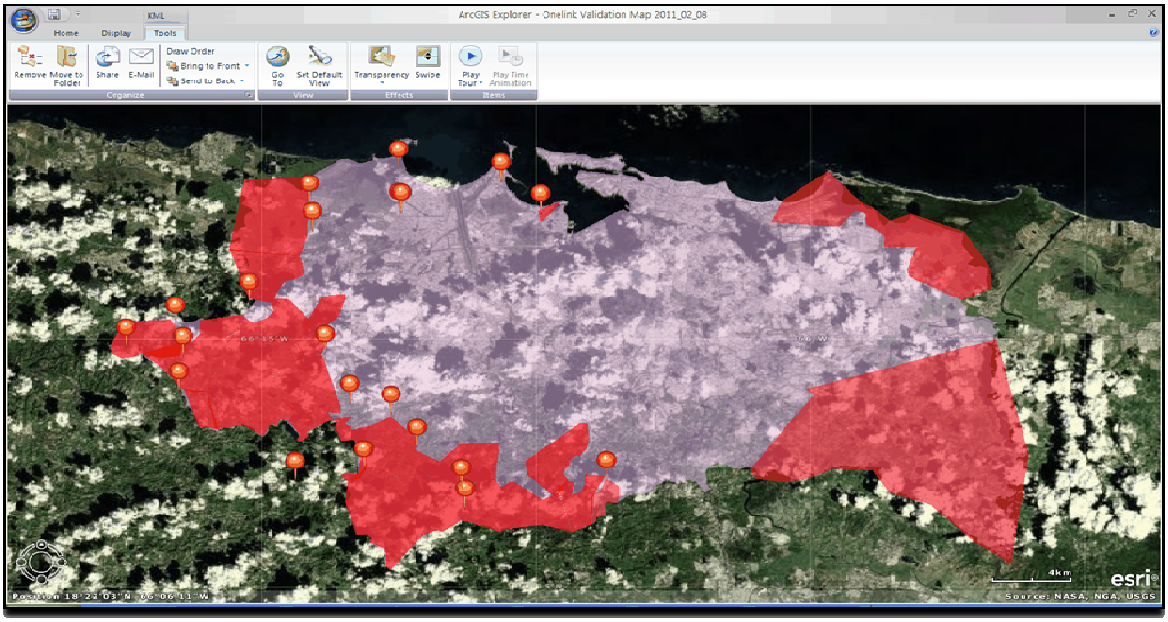


Using this combined coverage polygon as the basis for further investigation, Connected Nation set out on an exploratory "drive test" to determine where cable plant existed and estimate where cable modem likely existed in the greater San Juan area. During the period of February 7 - 11, 2011, Connected Nation deployed five ETS members (all highly trained former telecommunications operators) to conduct a thorough analysis of OneLink's "alleged" coverage area.

At the conclusion of this week-long exercise, Connected Nation had driven through several hundred miles of the OneLink franchise area, located above-ground and underground plant (consisting of both fiber and coaxial cable), visited with and surveyed numerous local residents inquiring about their broadband service, obtained collateral material from OneLink's local offices (to determine maximum advertised connection speeds) and created a polygon that illustrates the identified and likely coverage area of OneLink.

The image below shows the results of the validation efforts in terms of the revisions made to the advertised cable broadband availability in the greater San Juan area. Polygons in red demonstrate areas where Connected Nation reasonably believes broadband "gaps" exist in OneLink's franchise area. Connected Nation submitted the purple-shaded areas, along with full attributes, as the

estimate of OneLink's broadband service territory to the NTIA in the Puerto Rico SBDD broadband data submission of April 1, 2011.



Validation Achievements

In-field validations have proven to be the most reliable verification method of local broadband landscapes across jurisdictions mapped by Connected Nation. No other methodology can ascertain deployed asset coordinates, wireless broadband frequency and signal strength attributes, and physical plant locations as accurately as being there in person. The Connected Nation ETS team has discovered cable broadband services where they were not reported to exist, no cable broadband where it was reported to exist, missing DSL equipment, and wireless broadband towers at locations other than reported, which directly affects signal coverage area. All of this information is used to revise, refine, and reconfirm the mapping database that ultimately feeds the National Broadband Map.

Additionally, many fixed wireless providers operate "below the radar," meaning they are not a member of any association, and typically do not advertise their services, but they still offer a viable service with broadband speeds often exceeding those of DSL providers. The only dependable process to certify there is no fixed wireless broadband coverage in a given area is to conduct a frequency analysis with a spectrum analyzer across all available frequencies.